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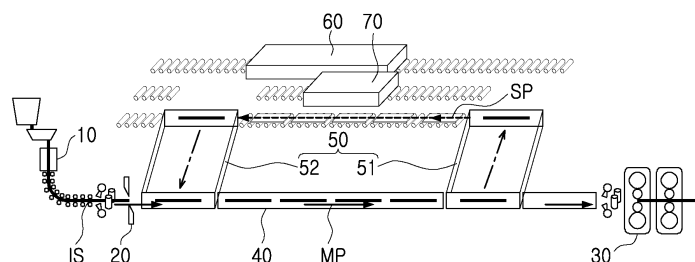
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(54) **CONTINUOUS CASTING AND ROLLING APPARATUS AND CONTINUOUS CASTING AND ROLLING METHOD**

(57) A continuous casting and rolling apparatus according to an embodiment of the present invention may include: a continuous casting device; a cutting device that is disposed at the output side of the continuous casting device and cuts an inner slab produced from the continuous casting device; a rolling device pressing down on the slab and disposed downstream of the continuous casting device in the moving direction of the inner slab; a tunnel furnace which is disposed between the cutting

device and the rolling device and heats the slab disposed on the main path of the inner slab that is transferred from the continuous casting device to the rolling device; and a loading adjustment unit which is disposed adjacent to the tunnel furnace and unloads the slab from the main path from the outlet side of the tunnel furnace and loads the slab onto the main path from the inlet side of the tunnel furnace.

【FIG. 1】



Description**[Disclosure]****[Technical Field]****[Technical Problem]**

[0001] The present invention relates to a continuous casting and rolling apparatus and a continuous casting and rolling method.

5 **[0009]** An object of the present disclosure is to provide a continuous casting and rolling apparatus for preventing a problem of a reduced actual yield of a slab while compensating for a temperature drop of the slab during an abnormal operation, and a continuous casting and rolling method.

[Background Art]

10 **[0010]** Another object of the present invention is to provide a continuous casting and rolling apparatus for scarfing a slab during the continuous casting or preventing a problem of wasted capacity of a rolling device, and a continuous casting and rolling method.

[0002] In a mini mill process, a layout is configured to directly roll a cut slab produced through a continuous casting process without cooling.

[0003] A tunnel furnace is installed as a space functioning as a buffer between a continuous casting device and a rolling device.

[Technical Solution]

[0004] This tunnel furnace serves as a space for connecting two continuous casting devices and a single rolling device and as a buffer space when a certain amount of time is required for rolling mill replacement. In order to compensate for a temperature drop while a slab remains in the space, a heater having a gas heating method or an inducted heating method is installed to compensate for the temperature drop.

20 **[0011]** According to an aspect of the present disclosure, a continuous casting and rolling apparatus may include a continuous casting device; a cutting device disposed on an outlet side of the continuous casting device and cutting an inner slab produced in the continuous casting device; a rolling device pressing a slab down and disposed downstream of the continuous casting device in a moving direction of the inner slab; a tunnel furnace provided between the cutting device and the rolling device and heating a slab located on a main path of the inner slab transferred from the continuous casting device to the rolling device; and a loading adjustment unit provided adjacent to the tunnel furnace, separating the slab on the main path from the tunnel furnace and introducing the slab onto the main path from an inlet side of the tunnel furnace.

[0005] In the mini mill process, however, the slab produced in the continuous casting device is promptly transferred to the rolling device to be rolled, thereby causing a problem that an actual yield is significantly reduced because the slab in the tunnel furnace and that newly produced in the continuous casting device are scrapped when an abnormal operation of the rolling device occurs for a long period of time. That is, the conventional mini mill process is advantageous in terms of energy in that it employs the continuous casting device and the rolling device directly connected to each other according to a flow of a material but is disadvantageous in that its ability to cope with abnormal operations is inferior.

25 **[0012]** The loading adjustment unit may include a drawing device provided adjacent to an outlet side of the tunnel furnace and separating the slab from the main path to be introduced onto a supplementary path; and an introducing device provided adjacent to the inlet side of the tunnel furnace and receiving the slab through the supplementary path to be introduced onto the main path

[0006] Further, an exterior material of a vehicle or a product required to meet stringent surface quality requirements is subject to a scarfing process after produced using a cut slab, which removes a surface defect generated during the continuous casting. To apply the scarfing to the mini mill process, however, a scarfing device needs to be installed online in consideration of the characteristics of the mini mill process, that is, the slab produced in the continuous casting device is promptly transferred to the rolling device. In this case, it may be disadvantageous in that the slabs, not subject to scarfing but in a region in which a scarfing device is installed, are cooled when scarfing is performed for selective slabs.

30 **[0013]** Further, the loading adjustment unit may introduce the inner slab, separated from the main path of the outlet side of the tunnel furnace by the drawing device, onto a main path of the inlet side of the tunnel furnace by the introducing device.

[0007] In addition, there may be a problem that the continuous casting device may not operate in the mini mill process, or rolling capacity of the rolling device may be wasted according to a slab production speed of the continuous casting device.

35 **[0014]** The continuous casting and rolling apparatus may further include a reheating device on the supplementary path between the introducing device and the drawing device and heating the slab on the supplementary path.

[0008] Accordingly, research into a continuous casting and rolling apparatus and a continuous casting and rolling method is required to solve the above issues.

40 **[0015]** The continuous casting and rolling apparatus may further include a scarfing device provided on the supplementary path between the introducing device and the drawing device and heating the slab on the supplementary path.

45 **[0016]** The introducing device may receive at least one of an inner slab produced in the continuous casting de-

vice and an outer slab transferred from the outside and introduce the same onto the main path.

[0017] A continuous casting and rolling method may include a process of supplying an inner slab, involving cutting an inner slab produced in a continuous casting device and supplying the same to a tunnel furnace; a rolling process involving pressing down the slab received from a main path of the slab moving through the tunnel furnace; and a subworking process performed between the process of supplying an inner slab and the rolling process and involving separating the slab on the main path from an outlet side of the tunnel furnace when the rolling process stops and introducing the slab onto the main path from an inlet side of the tunnel furnace when the rolling process resumes.

[0018] The subworking process may include a drawing process involving separating the slab on the main path from the outlet side of the tunnel furnace when the rolling process stops; and an introducing process involving receiving the slab separated from the main path of the outlet side of the tunnel furnace and introducing the same onto the main path of the inlet side of the tunnel furnace when the rolling process resumes.

[0019] The subworking process may include the introducing process subsequent to the drawing process so as to exclude intervention of another process therebetween, when the slab introduced onto the main path maintains a temperature for rolling.

[0020] The subworking process may further include a reheating process performed before the introducing process and involving heating the slab introduced onto the main path during the subworking process on the supplementary path when the slab has a temperature below the temperature for rolling.

[0021] The subworking process may further include a scarfing process performed before the introducing process and involving scarfing the slab separated from the main path of the outlet side of the tunnel furnace on the supplementary path through which the slab is delivered to be introduced onto the main path of the inlet side of the tunnel furnace.

[0022] The subworking process may further include a process of supplying an outer slab, performed before the introducing process and involving introducing the outer slab produced outside onto the supplementary path through which the slab separated from the main path of the outlet side of the tunnel furnace is delivered to be introduced onto the main path of the inlet side of the tunnel furnace.

[0023] The outer slab supply may be performed when capacity of the slab performing pressing down during the rolling process is larger than a supply amount of the inner slab.

[Advantageous Effects]

[0024] The continuous casting and rolling apparatus and the continuous casting and rolling method of the

present invention are advantageous in that a problem of a reduced actual yield of a slab can be prevented while a temperature drop of the slab can be compensated during an abnormal operation.

[0025] In another aspect, the continuous casting and rolling apparatus and the continuous casting and rolling method are advantageous in that scarfing can be performed for a slab during the continuous casting or a problem of wasted capacity of a rolling device can be prevented.

[Description of Drawings]

[0026]

FIG. 1 is a layout diagram illustrating a moving path of a slab in the continuous casting and rolling apparatus of the present invention during an abnormal operation.

FIG. 2 is a layout diagram illustrating a moving path of a slab compensating for a temperature loss in the continuous casting and rolling apparatus during an abnormal operation.

FIG. 3 is a layout diagram illustrating a moving path for scarfing of a slab in the continuous casting and rolling apparatus.

FIG. 4 is a layout diagram illustrating a moving path for receiving an outer slab in the continuous casting and rolling apparatus.

FIG. 5 is a layout diagram illustrating a moving path for receiving an outer slab and performing scarfing in the continuous casting and rolling apparatus.

FIG. 6 is a diagram illustrating an order of the continuous casting and rolling method of the present invention.

FIG. 7 is a diagram illustrating a subworking process during the continuous casting and rolling method.

[Best Mode for Invention]

[0027] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. Meanwhile, the spirit of the present invention is not limited to the suggested embodiments, and those skilled in the art to which the present invention pertains could easily suggest another embodiment which falls within the spirit of the present invention through the addition, modification, and deletion of another component without departing from the spirit of the present invention.

[0028] In the following description, components having the same function within the same scope illustrated in the drawings of the embodiments are illustrated by using the same reference numerals.

[0029] The present invention relates to a continuous casting and rolling apparatus and a continuous casting and rolling method. In the present invention, a problem of a reduced actual yield of a slab can be prevented, and

scarfing can be performed on a slab during the continuous casting. A problem of wasted capacity of a rolling device 30 can be prevented.

[0030] Specifically, with reference to the accompanying drawings, FIG. 1 is a layout diagram illustrating a moving path of a slab in the continuous casting and rolling apparatus of the present invention during an abnormal operation. Based on FIG. 1, a continuous casting and rolling apparatus according to an exemplary embodiment may include a continuous casting device 10; a cutting device 20 disposed on an outlet side of the continuous casting device 10 and cutting an inner slab IS produced in the continuous casting device 10; a rolling device 30 pressing a slab down and disposed downstream of the continuous casting device 10 in a moving direction of the inner slab IS; a tunnel furnace 40 provided between the cutting device 20 and the rolling device 30 and heating a slab located on a main path MP of the inner slab IS transferred from the continuous casting device 10 to the rolling device 30; and a loading adjustment unit 50 provided adjacent to the tunnel furnace 40, separating the slab on the main path MP from the tunnel furnace 40 and introducing the slab onto the main path MP from an inlet side of the tunnel furnace 40.

[0031] According to such configuration, the problem of a reduced actual yield, which may be caused by a defect of the rolling device 30 or a scrapped slab during an abnormal operation in which a rolling operation such as a replacement of a transfer roll is impractical, may be prevented.

[0032] In other words, the slab located in the tunnel furnace 40 or that produced by molten steel remaining in the continuous casting device 10 is separated from a main path MP of an outlet side of the tunnel furnace 40 by the loading adjustment unit 50 during the abnormal operation and introduced onto a supplementary path SP. The slab on the supplementary path SP is reintroduced onto the main path MP of an inlet side of the tunnel furnace 40, thereby increasing a time for which the slab is positioned on a moving path.

[0033] By securing a bypass, on which the slab remains without entering the rolling device 30, the slab can be prevented from being wasted by the scrap treatment due to insecurity of the path on which the slab remains.

[0034] Besides, the loading adjustment unit 50 introduces the slab introduced onto the main path MP onto an inlet side of the tunnel furnace 40, thereby compensating for a temperature of the slab lowered during its transfer through the supplementary path SP by a temperature at which the rolling can be performed.

[0035] The continuous casting device 10 may serve to produce an inner slab IS from the molten steel through a casting process. That is, the continuous casting device 10 supplies the molten steel to a mold in a tundish, and the supplied molten steel forms a cast while depriving heat. The inner slab IS is guided by a segment roll and a pinch roll and may be moved and supplied to the rolling device 30 to be described later.

[0036] Such continuous casting device 10, however, produces the internal cast steel IS depending on a solidification speed of the molten steel, it is difficult to control a production speed. Accordingly, production of a product by continuously receiving the inner slabs IS produced in the continuous casting device 10 and pressing down the same using the rolling device 30 has a limitation of a speed.

[0037] However, the inner slab released from the continuous casting device 10 has a high average temperature, it is advantageous in that a temperature required during the rolling operation can be guaranteed.

[0038] The cutting device 20 can serve to control whether a slab (inner slab IS or outer slab OS) performing the rolling in the rolling device 30 is provided as in a continuous form of being connected to the continuous casting device 10 or in a discontinuous form of being separated from the continuous casting device 10. To this end, the cutting device 20 is provided on an outlet side of the continuous casting device 10.

[0039] That is, when the cutting device 20 allows the inner slab IS to freely pass without cutting the same, the rolling device 30 receives the inner slab IS produced in the continuous casting device 10 in the continuous form of being connected to the continuous casting device 10 to perform the rolling. When the cutting device 20 cuts the inner slab IS and transfers the same to the rolling device 30, the rolling device 30 receives the inner slab IS in the discontinuous form of being separated from the continuous casting device 10 to perform the rolling.

[0040] When the rolling device 30 stops due to an abnormal operation, the inner slab IS needs to be introduced onto the supplementary path SP. In this regard, the cutting device 20 cuts the slab.

[0041] The rolling device 30 receives a slab, such as the inner slab IS produced in the continuous casting device 10 or an outer slab OS provided from outside, and presses the same to produce a natural or after product.

[0042] To this end, the rolling device 30 can allow the slab to go through a pair of rolling rolls to roll the slab, and several rolling stands providing such a pair of the rolling rolls may be provided.

[0043] As described above, the rolling device 30 can roll the slab while setting various rolling thicknesses.

[0044] The rolling device 30 may be provided as a rough rolling device 30 and a finish rolling device 30. The rough rolling device 30 has a configuration in which a slab produced in the continuous casting device 10 is first rolled, whereas the finish rolling device 30 has a configuration in which the slab rolled in the rough rolling device 30 is finish-rolled.

[0045] When the rolling thickness for the slab is satisfied by the rough rolling device 30, the finish rolling device 30 does not perform the rolling but may allow pairs of the rolling rolls to freepass the slab. Alternatively, when the rolling thickness for the slab is formed only by the operation of the finish rolling device 30, the rough rolling device 30 does not perform the rolling but may allow the

pairs of the rolling rolls to freepass the slab.

[0046] A heater for adjusting a rolling temperature of the slab or a scale-remover removing a scale may be provided on the inlet side of the rough rolling device 30 or the finish rolling device 30.

[0047] The tunnel furnace 40 serves to maintain or increase a rolling temperature of the slab when transferring the slab to the rolling device 30 and rolling.

[0048] To this end, the tunnel furnace 40 is provided between the continuous casting device 10 and the rolling device 30 and heats the slab, such as the inner slab IS produced in the continuous casting device 10 or an outer slab OS provided from outside, to maintain or increase the rolling temperature of the slab.

[0049] In another aspect, as a cooling speed can be adjusted as the temperature of the slab increases or a heating amount decreases, a material of the slab can also be adjusted.

[0050] To this end, the tunnel furnace 40 may be provided with a heating means such as a gas heating method, an induced heating method, or the like, and the tunnel furnaces 40 may be provided in plural according to a length thereof.

[0051] In particular, the slab is separated to the supplementary path SP from the main path MP of the inner slab IS delivered to the rolling device 30 from the continuous casting device 10 the tunnel furnace 40 on the outlet side of the tunnel furnace 40. In the meantime, the loading adjustment unit 50 introducing the slab from the supplementary path SP onto the main path MP may be connected to the inlet side of the tunnel furnace 40.

[0052] The loading adjustment unit 50 serves to separate a slab from the main path MP to be introduced onto the supplementary path SP on the outlet side of the tunnel furnace 40 while separating the slab from the supplementary path SP onto the main path MP on the inlet side of the tunnel furnace 40. This is to prevent the problems that the slab is scrapped and the actual yield thereof is lowered in presence of a defect of the rolling device 30 or a scrapped slab during an abnormal operation in which a rolling operation such as a replacement of a transfer roll, by expanding the path on which the slab remains to the supplementary path SP. This enables the slab to remain on the main path MP and the supplementary path SP without being abandoned until the operation is back to normalize.

[0053] To this end, the loading adjustment device may include a drawing device 51 and an introducing device 52. That is, the loading adjustment unit 50 of the continuous casting device according to an exemplary embodiment of the present invention is provided adjacent to the outlet side of the tunnel furnace 40 and to the inlet side of the tunnel furnace 40 and the drawing device 51 separating the slab from the main path MP to be introduced onto the supplementary path SP. The loading adjustment unit 50 may include the introducing device 52 receiving the slab through the supplementary path SP to be introduced onto the main path MP.

[0054] The drawing device 51, located on the outlet side of the tunnel furnace 40, serves to deliver the slab from the main path MP to the supplementary path SP. Accordingly, the moving path of the slab is expanded by changing the moving path of the slab toward the rolling device 30 from the outlet side of the tunnel furnace 40 to the supplementary path SP.

[0055] Such drawing device 51 may include a pusher pushing the slab on the transfer roll, but is not limited thereto. Any drawing device 51 can be used in the present invention as long as the slab can be delivered from the main path MP to the supplementary path SP.

[0056] The introducing device 52, located on the inlet side of the tunnel furnace 40, serves to deliver the slab from the supplementary path SP to the main path MP. Accordingly, the slab separated from the outlet side of the tunnel furnace 40 can be delivered toward the rolling device 30.

[0057] Further, as being provided on the inlet side of the tunnel furnace 40, the introducing device 52 enables the slab to be heated, thereby increasing the temperature of the slab, which has lowered while being transferred to the supplementary path SP, to a temperature at which the slab can be rolled.

[0058] Similarly to the drawing device, the introducing device 52 may include a pusher pushing the slab on the transfer roll, but is not limited thereto. Any introducing device 52 can be used in the present invention as long as the slab can be delivered from the supplementary path SP to the main path MP.

[0059] The loading adjustment unit 50 of the continuous casting device according to an exemplary embodiment may serve to introduce the inner slab IS separated from the main path MP of the outlet side of the tunnel furnace 40 by the drawing device 51 onto the main path MP of the inlet side of the tunnel furnace 40 by the introducing device 52.

[0060] That is, an additional configuration is not suggested for the moving path of the slab transferred from the drawing device 51 to the introducing device 52, and the slab can be configured to transfer while forming the supplementary path SP directly connecting the introducing device 52 to the drawing device 51.

[0061] When the supplementary path SP is formed as the above, a length thereof may be reduced depending on a number of the slabs to remain.

[0062] The length of the supplementary path SP is defined in consideration of an amount of the slab cooled on the supplementary path SP. That is, the temperature of the slab on the inlet side of the rolling device 30 in consideration of the amount of the cooled slab reduced on the supplementary path SP and a degree of a temperature increase in the tunnel furnace 40 added to the slab needs to be higher than a temperature at which the rolling is feasible. In such relationship, a maximum distance of the supplementary path SP is defined.

[0063] FIG. 2 is a layout diagram illustrating a moving path of a slab compensating for a temperature loss in the

continuous casting and rolling apparatus during an abnormal operation. Based thereon, the continuous casting device according to an exemplary embodiment is provided on the supplementary path SP between the drawing device 51 and the introducing device 52 and may include a reheater 60 heating the slab on the supplementary path SP.

[0064] The reheater 60 is further provided on the supplementary path SP as described above because the range for compensating for the temperature drop (cooling amount) of the remained slab on the path in the tunnel furnace 40 is exceeded according to an increasing amount of the slab, which needs to remain on the supplementary path SP.

[0065] This is the case in which the inner slab IS produced in the continuous casting device 10 is prevented from being disposed and an amount of the inner slab IS remaining on the main path MP or the supplementary path SP increases in the case of prolonged period of the abnormal operation.

[0066] Such reheater 60 may be configured as the tunnel furnace 40. That is, the reheater 60 may be provided with a heating means such as a gas heating method, an induced heating method, or the like, and may be provided in plural according to a length of a section which is heated.

[0067] FIG. 3 is a layout diagram illustrating a moving path for scarfing of a slab in the continuous casting and rolling apparatus. Based thereon, the continuous casting device according to an exemplary embodiment may include a scarfing device 70 provided between the introducing device 52 and the drawing device 51 on the supplementary path SP and scarfing the slab on the supplementary path SP.

[0068] The scarfing device 70 serves to scarf the inner slab IS or the outer slab OS according to a need of a product to be produced.

[0069] As an example, as the scarfing device 70 is provided on the supplementary path SP, not on the main path MP, a problem that a slab, which does not need to be scarfed, is unnecessarily cooled due to unnecessary waste of the main path MP is prevented. Further, selective scarfing is feasible for the slab in need of being scarfed.

[0070] FIG. 4 is a layout diagram illustrating a moving path for receiving an outer slab in the continuous casting and rolling apparatus, and FIG. 5 is a layout diagram illustrating a moving path for receiving an outer slab and performing scarfing in the continuous casting and rolling apparatus.

[0071] Based on FIGS. 4 and 5, the introducing device 52 of the continuous casting device according to an exemplary embodiment is configured to receive at least one of the inner slab IS produced in the continuous casting device 10 or the outer slab OP delivered from outside to introduce the same onto the main path MP.

[0072] That is, the introducing device 52 is not limited to providing the inner slab IS produced in the continuous casting device 10 to the rolling device 30 and rolling the

same; the introducing device 52 is configured to introduce the slabs produced outside, thereby preventing rolling capacity of the rolling device 30 from being wasted. This may serve to increase a production yield of a product produced by the rolling device 30.

[0073] Further, in consideration of the rolling capacity of the rolling device 30, a plurality of the continuous casting devices 10 may be connected to a single rolling device 30 to form the main path MP. In another aspect, a moving path of the slab connecting the main continuous casting device 10 and the rolling device 30 is formed as the main path MP, and the slab produced in another continuous casting device 10 is delivered to the rolling device through the supplementary path SP.

[0074] When the outer slab OS needs to be scarfed, a moving path passing the scarfing device 70 may be configured. A moving path passing the reheater 60 may be configured when additional heating is required.

[0075] FIG. 6 is a diagram illustrating an order of the continuous casting and rolling method of the present invention. Based thereon, a continuous casting and rolling method according to another exemplary embodiment involves a process of supplying an inner slab, involving cutting an inner slab produced in a continuous casting device 10 and supplying the same to a tunnel furnace 40; a rolling process involving pressing down the slab received from a main path MP of the slab moving through the tunnel furnace 40; and a subworking process performed between the inner slab supply process and the rolling process and involving separating the slab on the main path MP from an outlet side of the tunnel furnace 40 when the rolling process stops and introducing the slab onto the main path MP from an inlet side of the tunnel furnace 40 when the rolling process resumes.

[0076] The subworking process may serve to prevent a problem of a reduced actual yield, which may be caused by a defect of the rolling device 30 or a scrapped slab during an abnormal operation in which a rolling operation such as a replacement of a transfer roll is impractical.

[0077] That is, the slab located in the tunnel furnace 40 or that produced by molten steel remaining in the continuous casting device 10 is separated from the main path MP of the outlet side of the tunnel furnace 40 to be introduced onto the supplementary path SP during the abnormal operation. Alternatively, the slab on the supplementary path SP is introduced onto the main path MP of the inlet side of the tunnel furnace 40, thereby increasing a time for which the slab is positioned on a moving path.

[0078] By securing a bypass, on which the slab remains without entering the rolling device 30, the slab can be prevented from being wasted by the scrap treatment due to insecurity of the path on which the slab remains.

[0079] Besides, the slab introduced onto the main path MP is limited to be introduced onto the inlet side of the tunnel furnace 40, thereby compensating for a temperature of the slab lowered during its transfer through the supplementary path SP by a temperature at which the

rolling can be performed.

[0080] The process of supplying an inner slab involves producing of the inner slab IS using molten steel in the continuous casting device 10, and the rolling process involves pressing down the slab by the rolling device 30 to produce as a rolling product.

[0081] As previously described, the subworking process involves producing the supplementary path SP in addition to the main path, through which the inner slab IS is delivered to the continuous casting device 10 and the rolling device 30 such that the problem that the slabs are disposed during abnormal operations is prevented.

[0082] More specifically, the subworking process of the continuous casting and rolling method according to another exemplary embodiment may include a drawing process involving separating the slab on the main path from the outlet side of the tunnel furnace when the rolling process stops; and an introducing process involving receiving the slab separated from the main path of the outlet side of the tunnel furnace and introducing the same onto the main path of the inlet side of the tunnel furnace when the rolling process resumes.

[0083] That is, the drawing process involving delivering the slab from the main path MP to the supplementary path SP, and the introducing process involving delivering the slab from the supplementary path SP to the main path MP, are suggested.

[0084] The drawing and introducing processes are performed while not allowing another process to intervene therebetween such that an additional process is not performed on the supplementary path SP, and this facilitates a configuration of the slab remaining on the path.

[0085] That is, the subworking process of the continuous casting and rolling method according to another exemplary embodiment includes the introducing process subsequent to the drawing process so as to exclude intervention of another step therebetween, when the slab introduced onto the main path maintains a temperature for rolling when the slab introduced onto the main path maintains at least a temperature for rolling.

[0086] The subworking process is performed for a case in which a period of time for the abnormal operation is short enough that a cooling amount can be compensated in the tunnel furnace 40 while the slab remains on the supplementary path SP.

[0087] However, in the case of a prolonged period of the abnormal operation, the cooling amount of the slab remaining on the supplementary path SP increases, thereby disabling to secure the rolling temperature. In this case, the slab is reheated between the introducing and drawing processes.

[0088] That is, the subworking process of the continuous casting and rolling method according to another exemplary embodiment may include a reheating process performed before the introducing process and involving heating the slab introduced onto the main path MP during the subworking process on the supplementary path SP when the slab has a temperature below the rolling tem-

perature.

[0089] The reheating process may be performed in the reheater 60 provided on the supplementary path SP.

[0090] In addition, the subworking process of the continuous casting and rolling method according to another exemplary embodiment may include a scarfing process performed before the introducing process and involving scarfing the slab separated from the main path MP of the outlet side of the tunnel furnace 40 on the supplementary path SP through which the slab piece is delivered to be introduced onto the main path MP of the inlet side of the tunnel furnace 40.

[0091] The scarfing process may be performed in the case of producing an exterior material of a vehicle or a product required to meet stringent surface quality requirements.

[0092] To this end, the scarfing process is performed in a scarfing device 70 provided on the supplementary path SP. This may prevent a problem of the main path MP elongated by the scarfing device 70 as well as a problem of the slab on the main path MP being cooled.

[0093] Further, the subworking process of the continuous casting and rolling method according to another exemplary embodiment may include a process of supplying an outer slab, performed before the introducing process and involving introducing the outer slab OS produced outside onto the supplementary path SP through which the slab separated from the main path MP of the outlet side of the tunnel furnace 40 is delivered to be introduced onto the main path MP of the inlet side of the tunnel furnace 40.

[0094] That is, the subworking process is not limited to providing the inner slab IS during the inner slab supply process, and further includes supplying an outer slab OS introduced from outside.

[0095] The process of supplying an outer slab supply is further performed such that the problem of capacity of the rolling device 30 being wasted is prevented.

[0096] That is, the outer slab supply process of the continuous casting and rolling method according to another exemplary embodiment is performed when capacity of the slab pressed during the rolling process is larger than an amount of the inner slab IS being supplied.

[0097] While embodiments have been shown and described in detail above, it will be apparent to those skilled in the art that modifications and variations could be made without departing from the scope of the present disclosure as defined by the appended claims.

Claims

1. A continuous casting and rolling apparatus, comprising:

a continuous casting device;
a cutting device disposed on an outlet side of the continuous casting device and cutting an in-

- ner slab produced in the continuous casting device;
- a rolling device pressing a slab down and disposed downstream of the continuous casting device in a moving direction of the inner slab;
- a tunnel furnace provided between the cutting device and the rolling device and heating a slab located on a main path of the inner slab transferred from the continuous casting device to the rolling device; and
- a loading adjustment unit provided adjacent to the tunnel furnace, separating the slab on the main path from the tunnel furnace and introducing the slab onto the main path from an inlet side of the tunnel furnace.
2. The continuous casting and rolling apparatus of claim 1, wherein the loading adjustment unit comprises:
- a drawing device provided adjacent to an outlet side of the tunnel furnace and separating the slab from the main path to be introduced onto a supplementary path; and
- an introducing device provided adjacent to the inlet side of the tunnel furnace and receiving the slab through the supplementary path to be introduced onto the main path.
3. The continuous casting and rolling apparatus of claim 2, wherein the loading adjustment unit is configured to introduce the inner slab, separated from the main path of the outlet side of the tunnel furnace by the drawing device, onto a main path of the inlet side of the tunnel furnace by the introducing device.
4. The continuous casting and rolling apparatus of claim 2, wherein the apparatus comprises a reheating device on the supplementary path between the introducing device and the drawing device and heating the slab on the supplementary path.
5. The continuous casting and rolling apparatus of claim 2, wherein the apparatus comprises a scarfing device provided on the supplementary path between the introducing device and the drawing device and heating the slab on the supplementary path.
6. The continuous casting and rolling apparatus of claim 2, wherein the introducing device is configured to receive at least one of an inner slab produced in the continuous casting device and an outer slab transferred from the outside and introduce the same onto the main path.
7. A continuous casting and rolling method, comprising:
- a process of supplying an inner slab, involving cutting an inner slab produced in a continuous casting device and supplying the same to a tunnel furnace;
- a rolling process involving pressing down the slab received from a main path of the slab moving through the tunnel furnace; and
- a subworking process performed between the inner slab supply process and the rolling process and involving separating the slab on the main path from an outlet side of the tunnel furnace when the rolling process stops and introducing the slab onto the main path from an inlet side of the tunnel furnace when the rolling process resumes.
8. The continuous casting and rolling method of claim 7, wherein the subworking comprises:
- a drawing process involving separating the slab on the main path from the outlet side of the tunnel furnace when the rolling process stops; and
- an introducing process involving receiving the slab separated from the main path of the outlet side of the tunnel furnace and introducing the same onto the main path of the inlet side of the tunnel furnace when the rolling process resumes.
9. The continuous casting and rolling method of claim 8, wherein the subworking process involves the introducing process subsequent to the drawing process so as to exclude intervention of another step therebetween, when the slab introduced onto the main path maintains a temperature for rolling.
10. The continuous casting and rolling method of claim 8, wherein the subworking process further comprises reheating performed before the introducing process and involving heating the slab introduced onto the main path during the subworking on the supplementary path when the slab has a temperature below the temperature for rolling.
11. The continuous casting and rolling method of claim 8, wherein the subworking process further comprises a scarfing process performed before the introducing process and involving scarfing the slab separated from the main path of the outlet side of the tunnel furnace on the supplementary path through which the slab is delivered to be introduced onto the main path of the inlet side of the tunnel furnace.
12. The continuous casting and rolling method of claim 8, wherein the subworking process further comprises a process of supplying an outer slab, performed before the introducing process and involving introducing the outer slab produced outside onto the sup-

plementary path through which the slab separated from the main path of the outlet side of the tunnel furnace is delivered to be introduced onto the main path of the inlet side of the tunnel furnace.

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13. The continuous casting and rolling method of claim 12, wherein the process of supplying an outer slab is performed when capacity of the slab performing pressing down during the rolling process is larger than a supply amount of the inner slab.

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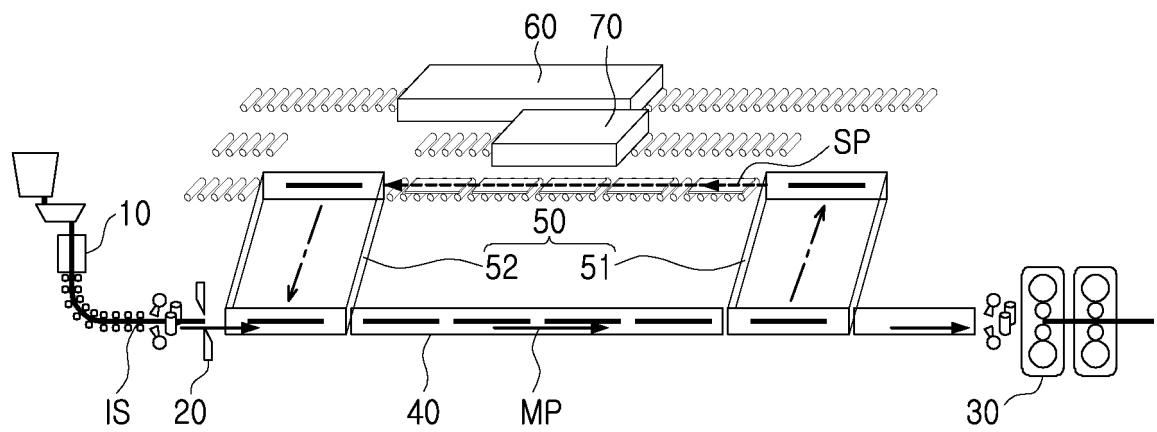
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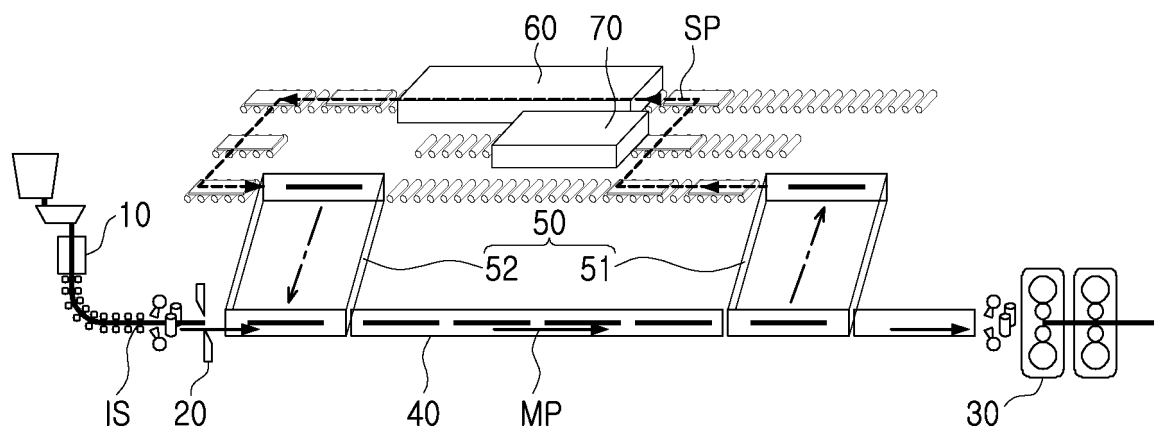
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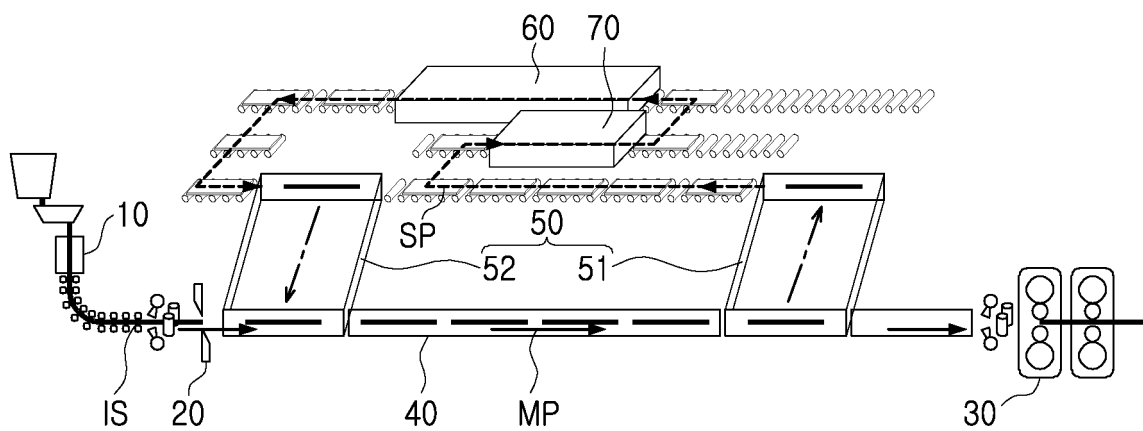
【FIG.1】



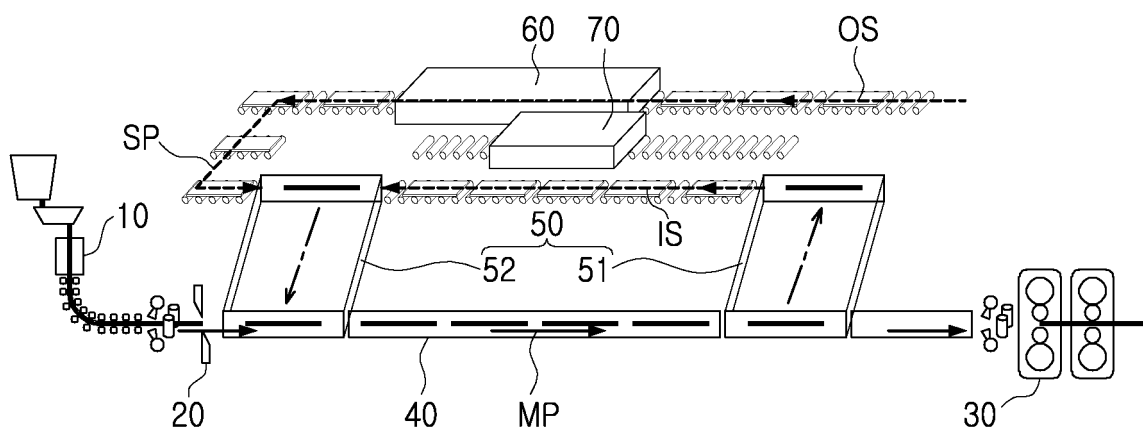
【FIG.2】



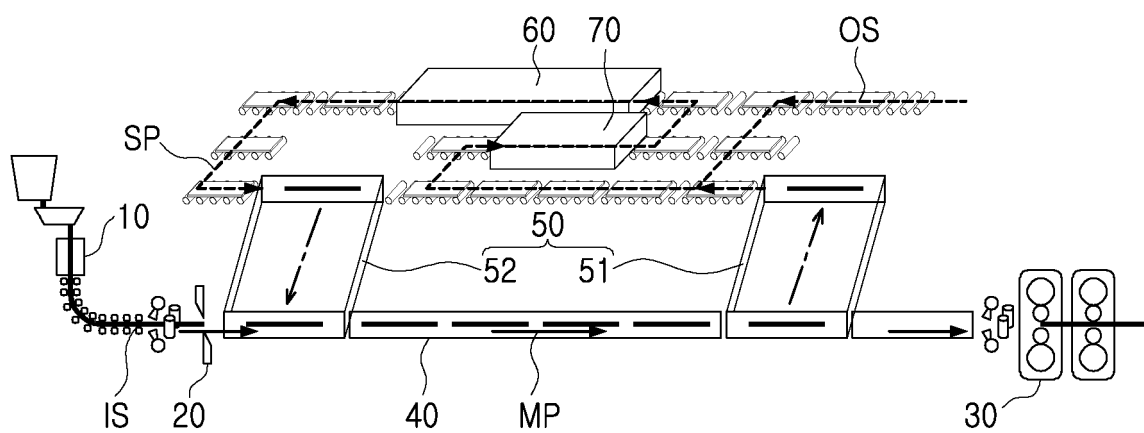
【FIG. 3】



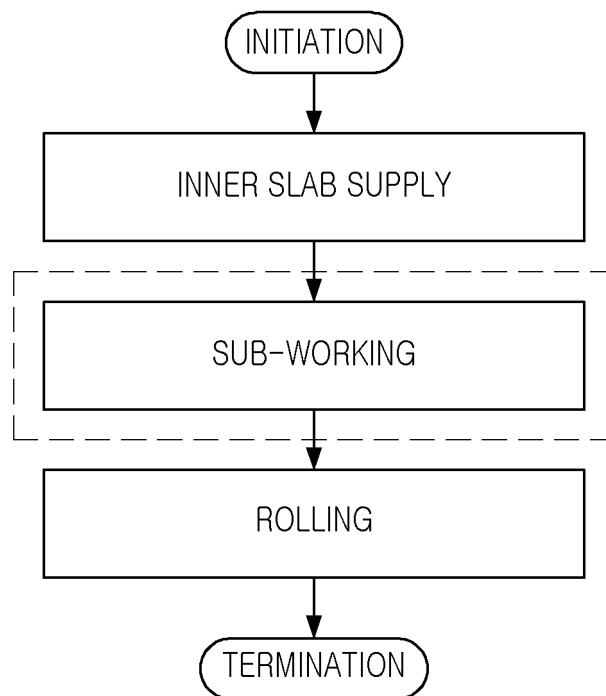
【FIG. 4】



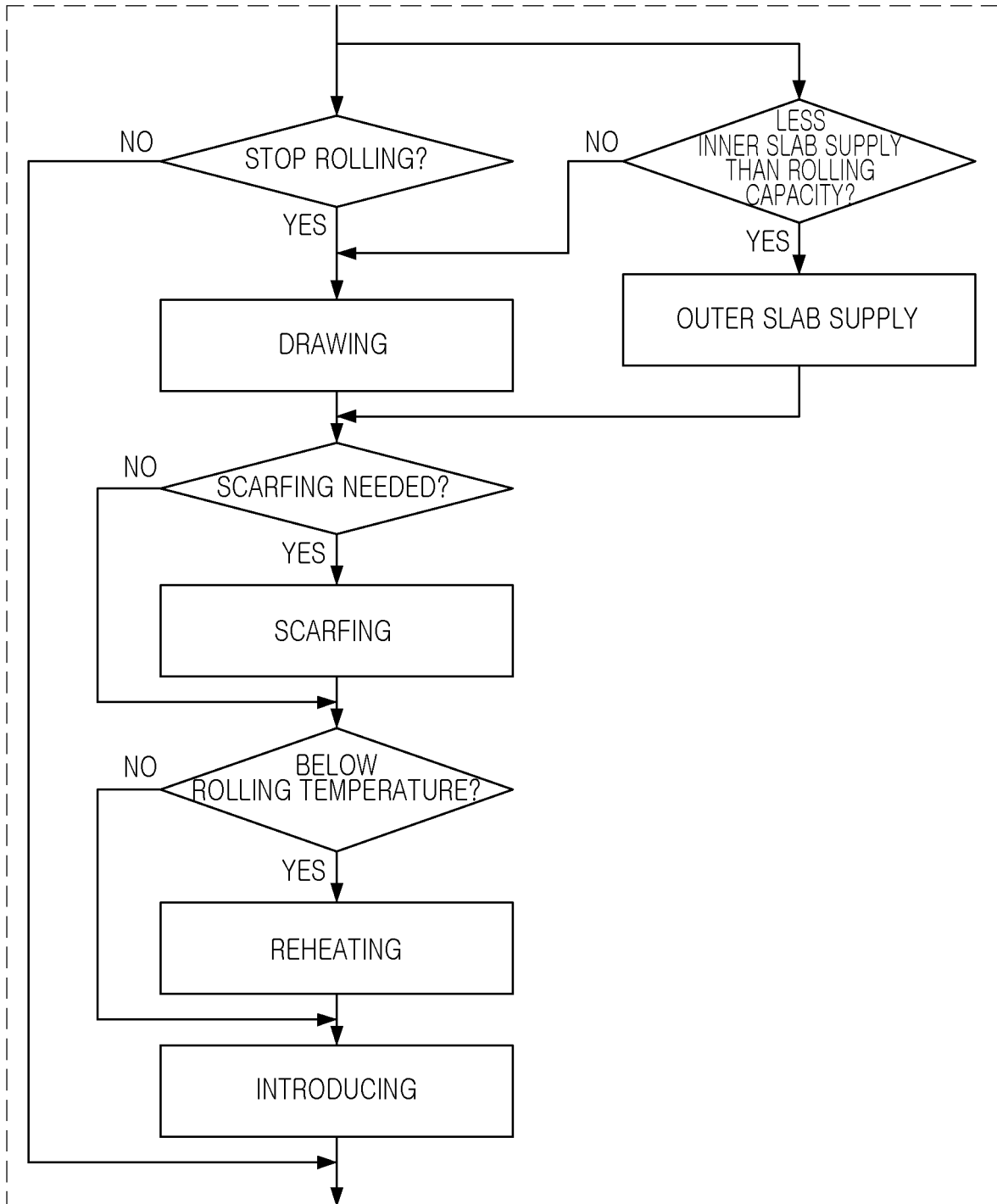
【FIG. 5】



【FIG. 6】



【FIG. 7】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2018/013277

A. CLASSIFICATION OF SUBJECT MATTER

B21B 1/46(2006.01)i, B21B 15/00(2006.01)i, B21B 45/00(2006.01)i, B21B 39/02(2006.01)i, B22D 11/12(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B21B 1/46; B21B 1/26; B21B 13/22; B21B 15/00; B21B 37/00; B21B 45/00; B22D 11/12; B23K 7/06; B21B 39/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: continuous casting machine, slab, cutting machine, rolling mill, tunnel furnace, loading control unit

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2016-0078572 A (POSCO) 05 July 2016 See paragraphs [0008]-[0040]; claims 1, 7; and figure 2.	1-3, 7-9
Y		4-6, 10-13
Y	KR 10-2011-0092101 A (POSCO) 17 August 2011 See paragraphs [0054]-[0068]; and figure 2a.	4-6, 10-13
A	JP 07-047418 A (ISHIKAWAJIMA HARIMA HEAVY IND., CO., LTD.) 21 February 1995 See paragraphs [0012]-[0031]; and figures 1-4.	1-13
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A	KR 10-2013-0075799 A (POSCO) 08 July 2013 See paragraphs [0035]-[0075]; and figures 2, 3a-3c, 4a-4c, 5.	1-13

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

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Date of the actual completion of the international search

12 FEBRUARY 2019 (12.02.2019)

Date of mailing of the international search report

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EP 3 705 198 A1

INTERNATIONAL SEARCH REPORT Information on patent family members

International application No.

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